I-95 Corridor Coalition
Vehicle Probe Project:
HERE, INRIX and TOMTOM
Data Validation

Report for Georgia (#03)
I-75

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Data Collected: October 16 to October 27, 2017
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Executive Summary

Wireless re-identification traffic monitoring (WRTM) data is collected to validate probe data that is procured through the I-95 Corridor Coalition's Vehicle Probe Project. WRTM data includes Bluetooth, Wi-Fi and other wireless traffic monitoring devices that collect signals emitted by in-vehicle electronic equipment. The specific device type used for each validation, will be determined based upon applicability and will be defined in the report. Specifications used for comparison include the Average Absolute Speed Error (AASE) and the Speed Error Bias (SEB).

- Both Bluetooth and Wi-Fi re-identification sensors were deployed at the beginning and ending points of 13 different segments along the I-75 corridor.
- Selected segments for I-75 corridor stretch from Exit 187 to Exit 222. (Refer to Figure 1 below).
- Travel time data was collected for the northbound direction along the corridor, between October 16 and October 27, 2017.
- The dataset collected represents approximately 2,971 hours of observations along 13 freeway segments, totaling approximately 36 miles.
- The total number of effective five-minute travel time samples observed was 37,174.
- Segment 3 was dropped from the final validation. There was concern that a time drift in the sensor's internal clock had failed and there was not 100% confidence in this ground truth sensor.
- The results are presented as compared against the mean of the ground truth data as well as the 95th percent confidence interval for the mean, referred to as the Standard Error of the Mean (SEM) band.

ES Table 1 provides a summary description of the study corridor.

ES Table 1-75 Corridor Description

Corridor Name	Number of Lanes	AADT	Speed Limit
I-75 Corridor	3 lanes	72,410	70 *mph*

ES Table 2, 3 and 4 below summarizes the results of the comparison between the WRTM reference data and the probe data from each vendor for freeway segments during the above noted time period.

ES Table 2- HERE Freeway Evaluation Summary for Georgia					
Speed Bin	**Average Absolute Speed Error (<10mph)**		**Speed Error Bias (<5mph)**		Number of 5 Minute Samples
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean	
0-30 MPH	2.14	2.96	0.95	1.22	412
30-45 MPH	3.78	5.38	2.91	3.70	257
45-60 MPH	4.01	7.12	3.54	6.22	842
>60 MPH	1.72	4.43	0.20	-0.14	35663
All Speeds	1.79	4.48	0.30	0.04	37174
Based upon data collected from October 16, through October 27, 2017 across 36 miles of roadway.					

- As shown for HERE data in ES Table 2, the average absolute speed error (AASE) was within specification (<10mph) in all speed bins.
- The Speed Error Bias (SEB) was within specification (<5mph) for all speed bins when compared with the Standard Error of the Mean (SEM) Band.

ES Table 3- INRIX Freeway Evaluation Summary for Georgia					
Speed Bin	**Average Absolute Speed Error (<10mph)**		**Speed Error Bias (<5mph)**		Number of 5 Minute Samples
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean	
0-30 MPH	2.51	3.34	2.05	2.55	412
30-45 MPH	5.10	6.67	4.89	6.14	257
45-60 MPH	5.17	8.38	4.90	8.14	842
>60 MPH	2.23	5.03	0.83	1.12	35663
All Speeds	2.31	5.10	0.96	1.33	37174
Based upon data collected from October 16, through October 27, 2017 across 36 miles of roadway.					

- As shown for INRIX data in ES Table 3, the average absolute speed error (AASE) was within specification (<10mph) in all speed bins.
- The Speed Error Bias (SEB) was within specification (<5mph) for all speed bins when compared with the Standard Error of the Mean (SEM) Band.

ES Table 4- TOMTOM Freeway Evaluation Summary for Georgia					
Speed Bin	**Average Absolute Speed Error (<10mph)**		**Speed Error Bias (<5mph)**		Number of 5 Minute Samples
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean	
0-30 MPH	2.70	3.58	1.33	1.74	412
30-45 MPH	4.70	6.32	3.22	3.91	257
45-60 MPH	4.37	7.58	3.74	6.54	842
>60 MPH	1.42	3.99	0.56	1.08	35663
All Speeds	1.53	4.08	0.66	1.23	37174
Based upon data collected from October 16, through October 27, 2017 across 36 miles of roadway.					

- As shown for TOMTOM data in ES Table 4, the average absolute speed error (AASE) was within specification (<10mph) in all speed bins.
- The Speed Error Bias (SEB) was within specification (<5mph) for all speed bins when compared with the Standard Error of the Mean (SEM) Band.

Methodology

Corridor Description and Data Collection

Travel time samples were collected along 13 freeway segments with the assistance of Georgia Department of Transportation (GDOT) personnel. Freeway segments studied were located on the I-75 corridor from Exit 187 to Exit 222. Travel time data was collected for the northbound direction along I-75 freeway segments between October 16 and October 27, 2017. Segments locations were chosen with a high-likelihood of observing recurrent and non-recurrent congestion during peak and off-peak periods.

Figure 1 presents an overview snapshot of the placement of sensors for the collection of data on I-75 corridor in Georgia. Markers shows the start and endpoint of freeway segments selected for analysis.

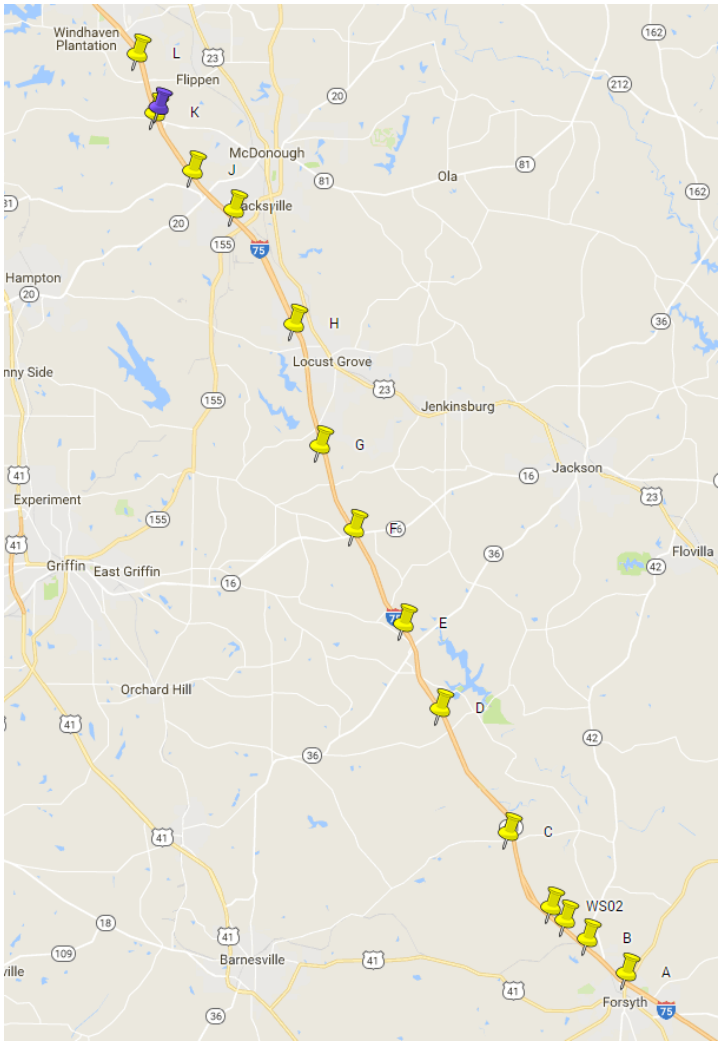

Figure 1- Locations of all segments selected on I-75 corridor for analysis in Georgia

TMC segments selected for validation in Georgia

Table 1 presents the data collection segments from Georgia. As a whole, these segments cover a total length of 36 freeway miles. Data collection segments are comprised of one or more Traffic Message Channel (TMC) base segments, such that the total length of the data collection segment is, in most cases, one mile or greater for freeways. When appropriate, consecutive TMC segments are combined to form a data collection segment longer than one mile. The results of the validation performed on 13 directional freeway segments are included in this report.

Table 1 contains the summary information on each data collection segment including the latitude/longitude coordinates of the locations at which the WRTM sensors were deployed along the I-75 corridor in Georgia as well as an active map link to view the data collection segment in detail. Click on the map link to see a detailed map for the respective data collection segment. It should be noted that the configuration of the test segments is often such that the endpoint of one segment coincides with the start point of the next segment, so that one WRTM sensor covers both data collection segments.

An algorithm was developed and documented in a separate report[1] as part of the initial VPP project and is being used for the validation of all vendors in VPPII. Details of the algorithm used to estimate equivalent path travel times based on probe data feeds for individual data collection segments are provided in this separate report. This algorithm finds an equivalent probe travel time (and therefore travel speed) corresponding to each sample WRTM travel time observation on the test segment of interest.

[1] Ali Haghani, Masoud Hamedi, Kaveh Farokhi Sadabadi, Estimation of Travel Times for Multiple TMC Segments, prepared for I-95 Corridor Coalition, February 2010 (link)

Table 1
Segments selected for validation in Georgia

Segment (Map Link)	DESCRIPTION					Deployment		
	Highway Direction	Starting at Ending at	Lane (Min) Lane (Max)	AADT (Min) AADT (Max)	Access Points Speed Limit	Begin Lat/Lon End Lat/Lon		Length (mile)
Freeway								
A1	I-75	GA-83/Exit 187	3	71,500	4	33.04080	-83.93380	1.79
GA03-0001	Northbound	GA-42/Exit 188	4	71,500	70	33.05800	-83.95680	
A2	I-75	GA-42/Exit 188	3	70,100	0	33.05800	-83.95680	0.97
GA02-0002	Northbound	Weigh Station Entrance	4	70,100	70	33.06680	-83.96901	
A3	I-75	Weigh Station Entrance	3	70,100	2	33.06680	-83.96901	0.65
GA03-0003	Northbound	Weigh Station Exit	4	70,100	70	33.07292	-83.97752	
A4	I-75	Weigh Station Exit	3	70,100	0	33.07292	-83.97752	2.94
GA03-0004	Northbound	Johnstonville Rd/Exit 193	4	70,100	70	33.10920	-84.00220	
A5	I-75	Johnstonville Rd/Exit 193	3	69,900	4	33.10920	-84.00220	4.94
GA03-0005	Northbound	High Falls Park Rd/Exit 198	4	69,900	40-70	33.16970	-84.04197	
A6	I-75	High Falls Park Rd/Exit 198	3	70,700	2	3.16970	-84.04197	3.16
GA03-0006	Northbound	GA-36/Exit 201	4	70,700	70	33.21084	-84.06336	
A7	I-75	GA-36/Exit 201	3	79,300	0	33.21084	-84.06336	3.57
GA03-0007	Northbound	GA-16/Exit 205	3	79,300	70	33.25650	-84.09180	
A8	I-75	GA-16/Exit 205	3	76,200	2	33.25650	-84.09180	3.15
GA03-0008	Northbound	Spalding-Henry County Border	4	76,200	70	33.29840	-84.11210	
A9	I-75	Spalding-Henry County Border	3	76,200	2	33.29840	-84.11210	4.13
GA03-0009	Northbound	Bill Gardner Pkwy/Exit 212	4	76,200	70	33.35660	-84.12650	
A10	I-75	Bill Gardner Pkwy/Exit 212	3	88,500	0	33.35660	-84.12650	4.42
GA03-0010	Northbound	GA-155/Exit 216	4	88,500	70	33.41240	-84.16250	

Table 2 (Cont'd)
Segments selected for validation in Georgia

Segment (Map Link)	DESCRIPTION					Deployment		
	Highway Direction	Starting at Ending at	Lane (Min) Lane (Max)	AADT (Min) AADT (Max)	Access Points Speed Limit	Begin Lat/Lon End Lat/Lon		Length (mile)
Freeway								
A11	I-75	GA-155/Exit 216	3	105,000	2	33.41240	-84.16250	1.88
GA03-0011	Northbound	GA-20/GA-81/Exit 218	4	105,000	70	33.43120	-84.18600	
A12	I-75	GA-20/GA-81/Exit 218	3	124,000	0	33.43120	-84.18600	2.30
GA03-0012	Northbound	Jonesboro Rd/Exit 221	4	124,000	65	33.45870	-84.20840	
A13	I-75	Jonesboro Rd/Exit 221	3	124,000	4	33.45870	-84.20840	2.08
GA03-0013	Northbound	Jodeco Rd/Exit 222	4	140,000	65	33.48760	-84.21860	

Analysis of Freeways

Following sections summarize the data quality measures obtained as a result of comparison between WRTM and all reported probe speeds. Specifications used for comparison include the Average Absolute Speed Error (AASE) and the Speed Error Bias (SEB).

Average Absolute Speed Error (AASE)

The AASE is defined as the mean absolute value of the difference between the mean speed reported from the VPP and the ground truth mean speed for a specified time period. The AASE is the primary accuracy metric. Based on the contract specifications, the speed data from the VPP shall have a maximum average absolute error of 10 miles per hour (MPH) in each of four speed ranges: 0-30 MPH, 30-45 MPH, 45-60 MPH, and > 60 MPH.

Speed Error Bias (SEB)

The SEB is defined as the average speed error (not the absolute value) in each speed range. SEB is a measure of whether the speed reported in the VPP consistently under or over estimates speed as compared to ground truth speed. Based on the contract specifications, the VPP data shall have a maximum SEB of +/- 5 MPH in each of speed ranges as defined above.

The results are presented as compared against the mean of the ground truth data as well as the 95th percent confidence interval for the mean, referred to as the Standard Error of the Mean (SEM) band. The SEM band takes into account any uncertainty in the ground truth speed as measured by WRTM equipment due to limited samples and/or data variance. Contract specifications are assessed against the SEM band. (See the *Vehicle Probe Project: Data Use and Application Guide* for additional details on the validation process.)

The AASE in the lower two speed bins have proven to be the critical specification (and most difficult) to attain.
It is important to consider that the weather ranged from rain to heavy rain during the data collection[2].

[2] The ground-truth data collected for this report as well as detailed daily comparison graphs for all segments are available for download upon request. Please email zvanderl@umd.edu for such inquiries.

Results

Analysis of Freeway Results for HERE Data

Table 2 shows the results of the comparison between the WRTM reference data and the HERE data. As stated before, the average absolute speed error (AASE) was within specification in all speed bins. The Speed Error Bias (SEB) was within specifications for all speed bins when compared with the Standard Error of the Mean (SEM) Band.

Table 3- HERE Data quality measures for freeway segments in Georgia

Speed Bin	Average Absolute Speed Error (<10mph)		Speed Error Bias (<5mph)		Number of 5 Minute Samples
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean	
0-30 MPH	2.14	2.96	0.95	1.22	412
30-45 MPH	3.78	5.38	2.91	3.70	257
45-60 MPH	4.01	7.12	3.54	6.22	842
>60 MPH	1.72	4.43	0.20	-0.14	35663
All Speeds	1.79	4.48	0.30	0.04	37174
Based upon data collected from October 16, through October 27, 2017 across 36 miles of roadway.					

Table 3 shows the percentage of the time the HERE data falls within 5 mph of the SEM band and the mean for each speed bin for all freeway data segments in this validation report.

Table 4- Percent observations meeting HERE data quality criteria for freeway segments in Georgia

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SEM Band		Mean		
	Percentage falling inside the band	Percentage falling within 5 mph of the band	Percentage equal to the mean	Percentage within 5 mph of the mean	
0-30	19%	89%	0%	82%	412
30-45	16%	70%	0%	59%	257
45-60	14%	66%	0%	29%	842
60+	46%	89%	0%	64%	35663

Analysis of Freeway Results for INRIX Data

Table 4 shows the results of the comparison between the WRTM reference data and the INRIX data. As stated before, the average absolute speed error (AASE) was within specification in all speed bins. The Speed Error Bias (SEB) was within specifications for all speed bins when compared with the Standard Error of the Mean (SEM) Band.

Table 5- INRIX Data quality measures for freeway segments in Georgia

Speed Bin	Average Absolute Speed Error (<10mph)		Speed Error Bias (<5mph)		Number of 5 Minute Samples
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean	
0-30 MPH	2.51	3.34	2.05	2.55	412
30-45 MPH	5.10	6.67	4.89	6.14	257
45-60 MPH	5.17	8.38	4.90	8.14	842
>60 MPH	2.23	5.03	0.83	1.12	35663
All Speeds	2.31	5.10	0.96	1.33	37174
Based upon data collected from October 16, through October 27, 2017 across 36 miles of roadway.					

Table 5 shows the percentage of the time the INRIX data falls within 5 mph of the SEM band and the mean for each speed bin for all freeway data segments in this validation report.

Table 6- Percent observations meeting INRIX data quality criteria for freeway segments in Georgia

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SEM Band		Mean		
	Percentage falling inside the band	Percentage falling within 5 mph of the band	Percentage equal to the mean	Percentage within 5 mph of the mean	
0-30	20%	86%	0%	81%	412
30-45	14%	64%	0%	53%	257
45-60	10%	54%	0%	21%	842
60+	40%	83%	0%	56%	35663

Analysis of Freeway Results for TOMTOM Data

Table 6 shows the results of the comparison between the WRTM reference data and the TOMTOM data. As stated before, the average absolute speed error (AASE) was within specification in all speed bins. The Speed Error Bias (SEB) was within specifications for all speed bins when compared with the Standard Error of the Mean (SEM) Band.

Table 7- TOMTOM Data quality measures for freeway segments in Georgia

Speed Bin	Average Absolute Speed Error (<10mph)		Speed Error Bias (<5mph)		Number of 5 Minute Samples
	Comparison with SEM Band	Comparison with Mean	Comparison with SEM Band	Comparison with Mean	
0-30 MPH	2.70	3.58	1.33	1.74	412
30-45 MPH	4.70	6.32	3.22	3.91	257
45-60 MPH	4.37	7.58	3.74	6.54	842
>60 MPH	1.42	3.99	0.56	1.08	35663
All Speeds	1.53	4.08	0.66	1.23	37174
Based upon data collected from October 16, through October 27, 2017 across 36 miles of roadway.					

Table 7 shows the percentage of the time the TOMTOM data falls within 5 mph of the SEM band and the mean for each speed bin for all freeway data segments in this validation report.

Table 8- Percent observations meeting TOMTOM data quality criteria for freeway segments in Georgia

SPEED BIN	Data Quality Measures for				No. of Obs.
	1.96 SEM Band		Mean		
	Percentage falling inside the band	Percentage falling within 5 mph of the band	Percentage equal to the mean	Percentage within 5 mph of the mean	
0-30	15%	84%	0%	77%	412
30-45	13%	57%	0%	45%	257
45-60	10%	70%	0%	18%	842
60+	50%	92%	0%	68%	35663

Appendix

Table A.1 to A.3 presents detailed data for individual TMC segments in this validation for all three vendors. Note that for some segments and in some speed bins the comparison results may not be reliable due to the small number of observations.

Table A. 1

HERE data quality measures for individual freeway validation segments in the state of Georgia

Path	Standard TMC length	Sensor distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
GA03-0001	1.79	1.79	0-30	0.31	0.31	-0.12	2.06	3*
			30-45	0.48	0.71	0.73	4.66	3*
			45-60	-1.24	2.61	-1.46	7.38	12*
			60+	-2.12	2.14	-6.45	6.66	3145
GA03-0002	4.56	0.97	0-30	-	-	-	-	-
			30-45	21.06	21.06	26.16	26.16	1*
			45-60	3.99	3.99	8.52	8.70	60
			60+	-0.51	0.85	-1.50	3.81	2649
GA03-0003	4.56	0.65	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	-	-	-	-	-
			60+	-	-	-	-	-
GA03-0004	2.94	2.94	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	3.62	3.62	6.47	6.70	16*
			60+	0.87	1.05	2.08	3.23	2895
GA03-0005	4.94	4.94	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	2.22	2.22	3.81	3.81	5*
			60+	-0.40	0.72	-1.17	2.74	3167
GA03-0006	3.44	3.16	0-30	-	-	-	-	-
			30-45	17.65	17.65	38.95	38.95	1*
			45-60	3.65	3.65	7.75	7.93	9*
			60+	-0.15	0.69	-0.38	2.74	3031
GA03-0007	4.07	3.57	0-30	-2.38	3.40	-2.94	4.20	18*
			30-45	9.61	9.61	18.19	18.19	3*
			45-60	3.98	4.04	8.32	8.49	64
			60+	1.09	1.19	2.85	3.63	2837
GA03-0008	3.15	3.15	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	6.10	6.10	8.77	8.77	33
			60+	-2.25	2.40	-5.76	6.24	3091
GA03-0009	4.13	4.13	0-30	0.70	2.33	0.73	3.01	22*
			30-45	1.00	2.98	1.74	4.88	18*
			45-60	0.82	2.77	2.36	5.28	48
			60+	0.02	1.15	0.20	3.28	3212
GA03-0010	4.42	4.42	0-30	1.65	3.21	1.79	3.67	83
			30-45	4.74	5.35	5.43	6.57	29*
			45-60	5.62	5.62	7.51	7.58	41
			60+	5.79	5.79	8.56	8.60	3090

*Results in the specified row labeled with an asterisk may not be reliable due to small number of observations. Based on the central limit theorem, the trigger for this result is when there are less than 30 observations

Table A. 2 (Cont'd)
HERE data quality measures for individual freeway validation segments in the state of Georgia

Path	Standard TMC length	Sensor distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
GA03-0011	1.88	1.88	0-30	1.33	1.52	1.89	2.36	127
			30-45	2.50	3.01	3.69	5.34	19*
			45-60	3.60	3.82	8.00	8.71	132
			60+	0.53	0.81	1.75	3.25	2955
GA03-0012	2.30	2.30	0-30	-0.57	1.40	-0.79	2.24	90
			30-45	-0.85	1.65	-1.69	2.94	63
			45-60	-1.98	2.51	-3.31	4.75	43
			60+	-1.92	1.94	-4.57	4.73	2942
GA03-0013	2.08	2.08	0-30	2.42	2.71	3.33	3.87	65
			30-45	4.46	4.46	5.70	5.70	117
			45-60	4.06	4.15	6.31	6.43	379
			60+	1.66	1.73	3.46	3.86	2593

*Results in the specified row may not be reliable due to small number of observations.

Table A.2 presents detailed data for individual TMC segments for INRIX. Note that for some segments and in some speed bins the comparison results may not be reliable due to the small number of observations.

Table A. 3

INRIX data quality measures for individual freeway validation segments in the state of Georgia

Path	Standard TMC length	Sensor distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
GA03-0001	1.79	1.79	0-30	0.42	0.42	2.54	3.27	3*
			30-45	2.03	7.16	1.40	9.88	3*
			45-60	2.55	2.55	7.71	7.71	12*
			60+	-1.33	1.50	-4.91	5.76	3151
GA03-0002	4.56	0.97	0-30	-	-	-	-	-
			30-45	25.06	25.06	30.16	30.16	1*
			45-60	5.73	5.73	10.82	10.82	60
			60+	-0.08	0.89	-0.41	3.84	2652
GA03-0003	4.56	0.65	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	-	-	-	-	-
			60+	-	-	-	-	-
GA03-0004	2.94	2.94	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	5.67	5.67	9.03	9.03	16*
			60+	1.63	1.68	3.20	3.96	2901
GA03-0005	4.94	4.94	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	10.71	10.71	14.01	14.01	5*
			60+	3.93	3.95	6.68	6.81	3173
GA03-0006	3.44	3.16	0-30	-	-	-	-	-
			30-45	20.65	20.65	41.95	41.95	1*
			45-60	8.97	8.97	15.19	15.19	9*
			60+	4.02	4.06	6.83	7.00	3037
GA03-0007	4.07	3.57	0-30	0.93	2.74	1.22	3.37	18*
			30-45	8.95	8.95	15.86	17.69	3*
			45-60	5.61	5.61	10.37	10.37	64
			60+	2.83	2.88	5.41	5.68	2843
GA03-0008	3.15	3.15	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	3.35	3.35	5.98	5.98	33
			60+	-3.98	4.05	-7.95	8.21	3092
GA03-0009	4.13	4.13	0-30	4.84	4.89	5.41	5.56	22*
			30-45	6.18	6.63	7.02	8.50	18*
			45-60	4.02	4.11	6.15	6.60	48
			60+	0.33	1.20	0.59	3.29	3217
GA03-0010	4.42	4.42	0-30	1.79	2.64	2.02	3.10	83
			30-45	4.64	4.83	5.75	6.12	30
			45-60	3.22	3.65	4.56	5.52	41
			60+	0.63	0.93	1.27	2.85	3095

*Results in the specified row may not be reliable due to small number of observations

Table A. 2 (Cont'd)
INRIX data quality measures for individual freeway validation segments in the state of Georgia

Path	Standard TMC length	Sensor distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
GA03-0011	1.88	1.88	0-30	1.91	2.02	2.51	2.91	129
			30-45	7.74	7.74	9.79	10.15	19*
			45-60	4.46	4.63	9.06	9.52	132
			60+	1.07	1.23	2.46	3.74	2959
GA03-0012	2.30	2.30	0-30	1.07	1.71	1.32	2.57	91
			30-45	3.02	3.43	3.81	4.72	64
			45-60	3.05	3.61	4.46	5.77	43
			60+	-1.34	1.57	-3.25	4.23	2946
GA03-0013	2.08	2.08	0-30	3.44	3.65	4.44	4.81	66
			30-45	4.97	4.97	6.15	6.16	118
			45-60	5.71	5.73	8.00	8.05	379
			60+	2.57	2.63	4.19	4.68	2597

*Results in the specified row may not be reliable due to small number of observations

Table A.3 presents detailed data for individual TMC segments for TomTom. Note that for some segments and in some speed bins the comparison results may not be reliable due to the small number of observations.

Table A. 4

TOMTOM data quality measures for individual freeway validation segments in the state of Georgia

Path	Standard TMC length	Sensor distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
GA03-0001	1.79	1.79	0-30	0.00	0.00	2.21	2.21	3*
			30-45	3.03	3.67	2.06	7.38	3*
			45-60	0.70	0.72	3.29	5.16	12*
			60+	-0.37	0.46	-2.83	3.66	3067
GA03-0002	4.56	0.97	0-30	-	-	-	-	-
			30-45	28.06	28.06	33.16	33.16	1*
			45-60	8.73	8.73	13.98	13.98	60
			60+	0.76	1.17	2.64	4.36	2569
GA03-0003	4.56	0.65	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	-	-	-	-	-
			60+	-	-	-	-	-
GA03-0004	2.94	2.94	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	6.86	6.86	10.22	10.22	16*
			60+	3.45	3.46	6.32	6.37	2823
GA03-0005	4.94	4.94	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	4.81	4.81	7.41	7.41	5*
			60+	1.06	1.14	2.86	3.45	3096
GA03-0006	3.44	3.16	0-30	-	-	-	-	-
			30-45	21.65	21.65	42.95	42.95	1*
			45-60	6.86	6.86	12.42	12.42	9*
			60+	1.23	1.25	3.41	3.74	2963
GA03-0007	4.07	3.57	0-30	0.89	3.05	0.78	3.85	18*
			30-45	15.77	15.77	23.86	23.86	3*
			45-60	6.99	6.99	11.82	11.82	64
			60+	3.04	3.05	6.02	6.12	2771
GA03-0008	3.15	3.15	0-30	-	-	-	-	-
			30-45	-	-	-	-	-
			45-60	11.16	11.16	13.86	13.86	33
			60+	-0.49	1.05	-2.25	3.83	3028
GA03-0009	4.13	4.13	0-30	-1.23	2.49	-1.64	3.14	22*
			30-45	-0.57	2.70	-0.76	4.50	18*
			45-60	2.78	3.21	4.80	5.76	48
			60+	0.93	1.46	1.97	3.71	3152
GA03-0010	4.42	4.42	0-30	-0.94	2.77	-1.07	3.22	83
			30-45	0.17	4.15	-0.02	5.44	30
			45-60	-0.49	3.18	-0.46	5.23	41
			60+	-0.02	0.33	0.27	2.00	3033

*Results in the specified row may not be reliable due to small number of observations

Table A. 5 (Cont'd)
TOMTOM data quality measures for individual freeway validation segments in the state of Georgia

Path	Standard TMC length	Sensor distance	SPEED BIN	Data Quality Measures for				No. of Obs.
				1.96 SEM Band		Mean		
				Speed Error Bias	Average Absolute Speed Error	Speed Error Bias	Average Absolute Speed Error	
GA03-0011	1.88	1.88	0-30	2.72	2.77	3.59	3.77	129
			30-45	2.36	2.77	4.11	5.26	19*
			45-60	2.76	3.15	7.41	8.03	128
			60+	-0.05	0.30	-0.09	2.30	2903
GA03-0012	2.30	2.30	0-30	0.63	1.87	0.68	2.80	91
			30-45	-0.81	2.10	-1.42	3.45	64
			45-60	-2.90	3.17	-4.17	5.33	43
			60+	-2.94	2.94	-6.15	6.16	2889
GA03-0013	2.08	2.08	0-30	3.47	3.75	4.49	4.87	66
			30-45	6.22	6.28	7.45	7.55	118
			45-60	3.28	3.39	5.50	5.72	373
			60+	0.39	0.60	1.54	2.33	2550

*Results in the specified row may not be reliable due to small number of observations